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JC956 U.S. PTO

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Attorney Docket No.: PA000028
Date: November 6, 2000
Express Mail Label No.: EL653020502US

JC945 U.S. PTO 09/707569 11/06/00

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Inventor(s): Paul E. Bender
For: METHOD AND APPARATUS FOR ADAPTIVE TRANSMISSION CONTROL IN A HIGH DATA RATE COMMUNICATION SYSTEM.

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CLAIMS:	(a) Filed	(b) Extra Claims	Large Entity Fee	Fee Paid
Total*	59 - 20	39	x $18 =	$702.00
Independent**	8 - 3	5	x $80 =	$400.00
Multiple Dependent Claim(s): ☐ No ☐ Yes			$270	$
APPLICATION FILING FEE			$710	$710.00
			TOTAL FEE	$1812.00

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METHOD AND APPARATUS FOR ADAPTIVE TRANSMISSION CONTROL IN A HIGH DATA RATE COMMUNICATION SYSTEM

The current invention relates to wireless data communication. More particularly, the present invention relates to a novel and improved method and apparatus for allocating resources in a high data rate (HDR) wireless communication system.

In the accompanying drawings:

FIG. 1 is a diagram of an HDR communication system.

FIG. 2a is a diagram of a reverse link frame and time slot channel structure.

FIG. 2b is a diagram of a reverse link access probe structure.

FIGS. 3a and **3b** are diagrams of forward link channel structures.

FIG. 4 is a diagram showing an exchange of messages used to establish a connection between an access terminal and an access network.

FIG. 5 is a diagram showing the structure of staggered fast access channels and a fast access indicator channel.

FIG. 6 is a diagram showing a fast access probe message sequence.

FIG. 7 is a flowchart showing an access terminal process for establishing a connection using a fast access channel.

FIG. 8 is a flowchart of a modem pool transceiver process for establishing a connection using a fast access channel

FIG. 9 shows an access terminal apparatus

FIGS. 10a and **10b** show a modem pool transceiver apparatus.

OVERVIEW

The presently disclosed embodiments are directed to an improved method and apparatus of allocating traffic channel resources in a high data rate (HDR) wireless communication system. An example HDR system is described in U.S. Patent Application Serial No. 08/963,386, assigned to the assignee of the present application, incorporated herein by reference, and hereinafter referred to as the '386 application. In the '386 application, a system is described wherein an HDR-capable subscriber station transmits data on a reverse link using a

CDMA waveform of multiple orthogonal channels. The access channel structure used in an HDR system is similar to that described in EIA/TIA-95B entitled "MOBILE STATION-BASE STATION COMPATIBILITY STANDARD FOR WIDEBAND SPREAD SPECTRUM CELLULAR SYSTEMS," familiar to those skilled in the art, and hereinafter referred to as "95B."

FIG. 1 is a diagram of an example HDR communication system. An HDR subscriber station, referred to herein as an access terminal (AT) **102**, may be mobile or stationary, and may communicate with one or more HDR base stations, referred to herein as modem pool transceivers (MPTs) **108**. An access terminal **102** transmits and receives data packets through one or more modem pool transceivers **108**, to an HDR base station controller, referred to herein as a modem pool controller (MPC) **110**. Modem pool transceivers and modem pool controllers are parts of a network called an access network. An access network transports data packets between multiple access terminals. The access network may be further connected to additional networks outside the access network, such as a corporate intranet or the Internet, and may transport data packets between each access terminal and such outside networks. An access terminal that has established an active traffic channel connection with one or more modem pool transceivers is called an active access terminal, and is said to be in a traffic state. An access terminal that is in the process of establishing an active traffic channel connection with one or more modem pool transceivers is said to be in a connection setup state. An access terminal may be any data device that communicates through a wireless channel or through a wired channel, for example using fiber optic or coaxial cables. An access terminal may further be any of a number of types of devices including, but not limited to PC card, compact flash, external or internal modem, or wireless or wireline phone. The communication link through which the access terminal **102** sends signals to the modem pool transceiver **106** is called a reverse link. The communication link through which a modem pool transceiver **108** sends signals to an access terminal **102** is called a forward link **106**.

The word "exemplary" is used exclusively herein to mean "serving as an example, instance, or illustration." Any embodiment described as an "exemplary embodiment" is not to be construed as necessarily preferred or advantageous over other embodiments described herein.

FIG. 2a is a diagram of an example reverse link channel structure. The reverse link channel is divided in time into a series of consecutive reverse link frames **202**, with each frame being subdivided into a series of consecutive reverse link slots **204**. The access terminal transmits a continuous stream of reverse link frames, with each reverse link frame **202b** beginning in time at the

end of the previous frame **202a**. The time durations of the reverse link frames and slots may be constant, or may vary. In an exemplary embodiment, reverse link frames have a constant duration of 26.67 milliseconds, and consist of sixteen reverse link slots **204**. In an exemplary embodiment, reverse link slots **204** have a constant duration of 1.667 milliseconds. An access terminal (not shown) may transmit pilot signals, medium access control (MAC) signals, and data signals during each time slot **204**. The access terminal may also transmit a subset of the three signals during a particular slot **204**. For example, the access terminal may transmit just a pilot signal, and not MAC or data signals during a particular slot **204**. In an exemplary embodiment, the access terminal transmits pilot and MAC signals **250** as an in-phase component of the reverse link signal, and transmits data signals **252** as a quadrature-phase component of the reverse link signal.

In an exemplary embodiment, the types of reverse link channels include access channels and traffic channels, each of which further includes a data channel, a pilot channel, and a MAC channel. The MAC channel includes a reverse data rate control (DRC) channel and a reverse rate indicator (RRI) channel. In an exemplary embodiment, and as shown in **FIG. 2b**, the first part of a fast access probe **242** is a fast access probe preamble **244**, during which a pilot signal **248** is transmitted. After transmitting a fast access probe preamble **244**, the access terminal transmits a fast access probe body **246**, including the pilot/MAC **250**, and access channel data packet **252** signals. In an exemplary embodiment, the different portions of the fast access probe body **246** are transmitted using quadrature phase shift keying (QPSK). The pilot and MAC channel signal portion **250** of the fast access probe **242** are transmitted as the in-phase (I phase) portion of the reverse link signal. The access channel data packet **252** portion of the fast access probe **242** is transmitted as the quadrature-phase (Q phase) portion of the reverse link signal. In an exemplary embodiment, the access terminal does not transmit using the reverse DRC channel while transmitting a fast access probe **242**. In an exemplary embodiment, the fast access probe preamble **244** has a duration of one frame **202** and the fast access probe body **246** has a duration of two frames **202**. Alternatively, the durations of both the fast access probe preamble **244** and the fast access probe body **246** may be longer or shorter than as described above. For example, the fast access probe preamble **244** may be two frames long or the fast access probe body **246** may be one or three frames long.

The various portions of a fast access probe preamble **244** may alternately be arranged differently than the described exemplary embodiment without departing from the scope of the present invention. For example, the pilot,

MAC, and access channel data packet signals could be separated using separate orthogonal spreading codes, distributed differently among the in-phase and quadrature-phase reverse link signal components, or time-division multiplexed.

FIG. 3a is a diagram of an example forward link channel structure. In an exemplary embodiment, a modem pool transceiver (not shown) transmits data in time slots of a fixed duration **312**. Each time slot is divided into two half-slots **310a** and **310b**. In an exemplary embodiment, the time slots have a fixed length of 2048 symbol chips and a duration of 1.667 milliseconds, and each half-slot has a fixed length of 1024 symbol chips. One skilled in the art will recognize, however, that these lengths and durations may vary over time or have different values without departing from the scope of the present invention. In an exemplary embodiment, a data pilot burst **306** having a duration of 96 chips is transmitted at the center of each half-slot **310**. In each frame **312**, the modem pool transceiver transmits MAC channel signals **308** immediately before and after the data pilot burst **306b** transmitted in the center of the latter half-slot **310b**. The remaining portions **302** of each time slot **312** contain forward link packet data.

FIG. 3b shows an alternate embodiment of the example forward link channel structure of **FIG. 3a**. In **FIG. 3b**, an additional set of forward MAC channels **304** are transmitted immediately before and after the data pilot burst **306a** transmitted in the center of the first half-slot **310a**.

FIG. 4 is a diagram showing an example exchange of forward and reverse link messages between an access terminal (AT) and a modem pool transceiver (MPT). At some time before the access terminal attempts an access, the modem pool controller (MPC) assigns a universal access terminal identification (UATI) to the access terminal by sending a UATI assignment message **402** containing the UATI to the access terminal. When subsequently initiating a connection with a modem pool transceiver, the access terminal sends a fast access probe **404** containing a connection request message on a fast access channel. Upon detecting the fast access probe preamble, and without waiting to receive the fast access probe body portion of the fast access probe **404**, the modem pool transceiver sends a fast access indicator **406**. Upon detecting the fast access indicator, the access terminal then begins transmitting a reverse traffic signal **408**. The reverse traffic signal **408** includes DRC information that allows the modem pool transceiver to transmit rate-controlled data to the access terminal. Upon complete decoding of the connection request message contained within the fast access probe **404** and the reverse traffic signal **408**, the modem pool transceiver sends a combined message **410** on a fast connect reverse traffic channel. The combined message **410** contains an access

acknowledgment message, a traffic channel assignment message, and a reverse traffic channel acknowledgment message. Because the modem pool transceiver receives a DRC signal from the access terminal within the reverse traffic signal **408**, the combined message **410** can be sent at the requested DRC data rate. After the access terminal receives the combined message **410**, the access terminal may begin exchanging data packets **412** with the modem pool controller through the modem pool transceiver.

DETAILED DESCRIPTION

In an exemplary embodiment, fast access channels are used to carry exclusively connection request messages. In an exemplary embodiment as shown in **FIG. 4**, an access terminal transmits a connection request message **404** on a fast access channel. In an exemplary embodiment, the access terminal chooses one of a plurality of fast access channels that are staggered in time. In addition to time staggering, the different fast access channels can be made more distinguishable by encoding each using a different pseudonoise (PN) long code mask. For example, the fast access channel long code mask may incorporate eight bits selected from the system time value in order to provide separate PN long codes for 256 fast access channels. In an alternate embodiment, three bits from the system time value are used in the fast access channel long code mask to provide eight fast access channels.

In an exemplary embodiment, the long code masks used to generate fast access channels are also different than the long code mask associated with the ordinary access channel. Messages sent on the ordinary access channel include registration messages, so the access network may not assume from the probe preamble that the probe body contains a connection request message. The access network therefore does not send a fast access indicator in response to probe preambles received on the ordinary access channel.

Upon detecting the preamble portion of the received fast access probe **404**, the modem pool transceiver sends a fast access indicator **406** while continuing to decode the fast access probe body. The modem pool transceiver compares the signal quality of the received fast access probe preamble to a decoding threshold to determine whether to respond by sending a fast access indicator **406**. This decoding threshold is chosen carefully so that, once the fast access probe preamble threshold has been met, it will be unlikely that a modem pool transceiver will fail to decode the following fast access probe body.

In an exemplary embodiment, the forward MAC channel comprises a plurality of code sub-channels, each identified by a MAC index and transmitted

using a unique 32-ary Walsh cover. In one such embodiment, the fast access indicator **406** is sent using one of the code sub-channels included in the MAC channel. The code sub-channels may alternatively use Walsh covers of a different length, for example 64-ary or 128-ary Walsh covers. Furthermore, any other channelization technique may be used to distinguish sub-channels within the MAC channel. In an embodiment using 32-ary Walsh covers, the available MAC sub-channels are numbered from 1 to 31, where a MAC index i is assigned to the 32-ary Walsh function W_i^{32}, such that W_1^{32}, is the second Walsh code within the 32-ary Walsh function and Walsh code zero is not used.

The modem pool transceiver uses a subset of the 31 MAC code sub-channels to send reverse power control commands to access terminals. The gains of the MAC code sub-channels are normalized and individually scaled to control the total forward MAC channel power. In an exemplary embodiment, these gains are varied over time for efficient utilization of the total MAC channel transmit power while still maintaining reliable transmission of reverse power control (RPC) signals to active access terminal.

Each modem pool transceiver that establishes a connection with an access terminal assigns an RPC index from a set of RPC code channels. The RPC code channels comprise a subset of the modem pool transceiver's forward link MAC code sub-channels. The RPC index defines the Walsh cover used by the modem pool transceiver to transmit the RPC bit stream destined from the modem pool transceiver to that access terminal. Additionally, the RPC index may define the quadrature phase shift keying (QPSK) modulation phase (e.g. in-phase or quadrature) used to transmit the RPC bit stream. One RPC bit is transmitted to each active access terminal in each time slot. In an exemplary embodiment, the MAC channel transmissions **308a** and **308b** (from **FIG. 3**) each have a duration of 64 chips. The RPC bit is transmitted as four copies of the 32-ary Walsh function having an index i corresponding to the intended destination access terminal. Together, the four copies of the 32-ary Walsh function have the same length as the two 64-chip MAC channel periods **308a** and **308b** of each forward link time slot. In an exemplary embodiment, 600 RPC bits per second are transmitted to each active access terminal.

A greater RPC bit rate or number of MAC code sub-channels can be obtained by changing the rate of symbol repetition or the Walsh functions used. For example, an RPC bit rate of 1200 bits per second could be achieved by repeating each RPC bit twice in each slot instead of four times. Or a 64-bit Walsh function could be used to double the number MAC code sub-channels available for RPC signals to different access terminals, with each 64-bit Walsh

function being transmitted twice in a slot (before and after the second data pilot burst **306b**).

Turning back to **FIG. 4**, after receiving the fast access indicator **406**, the access terminal begins transmitting a reverse traffic signal **408**. In an exemplary embodiment, the reverse traffic signal **408** is sent on a fast connect reverse traffic channel, and consists of reverse link null traffic. Reverse link null traffic consists essentially of a pilot signal and a DRC signal, and contains no user data. In order to send the reverse traffic signal **408** before receiving a traffic channel assignment, the access terminal covers the DRC signal with a predetermined fast connect reverse traffic channel Walsh cover. In this way, the DRC signal within the reverse traffic signal **408** is specifically directed to the modem pool transceiver that sent the fast access indicator **406**.

The use of a predetermined fast connect reverse traffic channel Walsh cover is one difference between a fast connect reverse traffic channel and a non-fast-connect traffic channel. In an exemplary embodiment, an access terminal in a traffic state is provided with a different DRC Walsh code for each modem pool transceiver in the access terminal's "active set." Active sets as described herein have been defined in numerous references including Telecommunications Industry Association standard TIA/EIA-95-B, and are well known in the art. The access terminal directs a DRC message to a selected modem pool transceiver by covering the DRC message with the Walsh code corresponding to the selected modem pool transceiver. Each modem pool transceiver in the access terminal's active set decovers the DRC signals from the access terminal using its corresponding DRC Walsh cover. Consequently, only the selected modem pool transceiver can correctly decode the DRC signal and send forward link data to the access terminal in a following forward link time slot. The DRC message symbols destined for a particular modem pool transceiver are exclusively OR'ed (XOR) with the corresponding Walsh code. When receiving DRC messages from an access terminal, a modem pool transceiver performs the same XOR operation using the Walsh code assigned to the modem pool transceiver for the access terminal. Since each modem pool transceiver in the active set of the mobile station is identified by a unique Walsh code, only the selected destination modem pool transceiver can correctly decode the DRC message.

However, the messages used to establish a traffic channel are sent before an active set has been identified, and before the access terminal receives Walsh code assignments for any modem pool transceivers. The predetermined fast connect reverse traffic channel Walsh cover is known by both access terminal and modem pool transceiver. Using this fast connect reverse traffic channel

Walsh cover, the access terminal sends DRC messages to a modem pool transceiver prior to establishing a traffic channel. This enables the modem pool transceiver to send forward link messages to the access terminal at a controlled rate prior to establishing a traffic channel. Such pre-traffic-channel messages include access probe acknowledgment, reverse traffic channel acknowledgment, and traffic channel assignment messages.

The controlled rate is generally greater than the uncontrolled rate of the normal paging and other forward control channels. Because normal paging and other forward control channels are shared among all access terminals, they are transmitted at slow data rates to allow proper decoding by even access terminals operating under the worst interference conditions. For this reason, transmission of controlled-rate messages on the forward link is more efficient and consumes less forward link capacity. Even while the access terminal sends DRC signals on the reverse link, the modem pool transceiver may still opt to send forward link messages to the access terminal using an uncontrolled rate channel instead of a rate-controlled channel. For example, the modem pool transceiver may choose to send access acknowledgment messages, traffic channel assignment messages, or reverse traffic channel acknowledgments using the forward control channel. So, even while transmitting DRC messages on a fast connect reverse traffic channel, the access terminal continues to monitor the normal paging and forward control channels.

When transmitting a fast access indicator **406**, the modem pool transceiver continues to receive the fast access probe body portion of the fast access probe **404**. Upon successfully decoding all portions of the fast access probe **404**, the modem pool transceiver may send an access probe acknowledgment message. The access probe acknowledgment message indicates the successful, complete decoding of the fast access probe **404**.

In an exemplary embodiment, an access terminal is assigned a universal access terminal identification (UATI) prior to establishing a connection to the access network. The UATI is associated with specific resources within a modem pool controller, for example a reverse link protocol (RLP) state entry in a table within the modem pool controller. The modem pool transceiver does not assign the UATI, but includes the UATI with any traffic state messages forwarded to the modem pool controller after being received from the access terminal. In an exemplary embodiment, the UATI is also the Internet protocol (IP) address of the modem pool transceiver within the wireless network, and remains assigned to the access terminal even after the access terminal leaves the traffic state. When an access terminal establishes a new connection, a UATI obtained previously can be sent in a connection request message within the fast

access probe **406**. If the modem pool controller has not reassigned network resources associated with the UATI, the same resources can be immediately reallocated to the access terminal for the new connection. This allows the access terminal to transmit reverse link data instead of just null traffic over the fast connect reverse traffic channel. Because the access terminal already has a UATI that is equivalent to an IP address, reverse link packets bearing that UATI can be routed even before the access terminal receives a traffic channel allocation.

In an exemplary embodiment, the connection request message includes the UATI. After successfully decoding the UATI from the connection request message in the fast access probe **406**, the modem pool transceiver can determine the reverse link PN long code used by the access terminal and acquire the reverse traffic signal **408**. Once the reverse traffic signal **408** is successfully acquired, the modem pool transceiver can decode DRC messages and send access probe acknowledgment, reverse traffic channel acknowledgment, and traffic channel assignment messages at the requested DRC rate. The access network can send the traffic channel assignment message either before or after actually allocating a traffic channel.

In an exemplary embodiment, the modem pool transceiver may send the access probe acknowledgment, reverse traffic channel acknowledgment, and traffic channel assignment message individually or may combine two or more of the messages into a single forward link message. The forward link messages may be sent over a forward common control channel or a forward rate-controlled common channel. The forward common control channel is sent at a constant, relatively low data rate. The data rate of the forward rate-controlled common channel is determined according to DRC messages transmitted over the fast connect reverse traffic channel.

In an exemplary embodiment, the forward rate-controlled common channel is distinguished from the forward common control channel using a predetermined forward rate-controlled common channel Walsh code. This Walsh code is used to cover the preamble of forward link messages sent over the forward rate-controlled common channel. In this way, an access terminal that transmits DRC messages on the fast connect reverse traffic channel can distinguish corresponding forward link responses from forward traffic channel transmissions to other access terminals. In an exemplary embodiment, the modem pool transceiver uses a 32-ary Walsh cover to distinguish the forward rate-controlled common channel from other forward traffic channels. Alternatively, longer or shorter Walsh covers may be used.

After acquiring the reverse traffic signal **408**, the modem pool transceiver can decode the DRC information received in the reverse traffic signal **408**. The

modem pool transceiver may then send forward link messages to the access terminal using the forward rate-controlled common channel at the data rate specified by the received DRC signal. In an exemplary embodiment, the modem pool transceiver sends all three messages (access probe acknowledgment, traffic channel assignment, and reverse traffic channel acknowledgment) within a combined forward link message **410** over the forward rate-controlled common channel. If the specified DRC data rate is sufficiently fast, the combined forward link message **410** may be sent in a single forward link frame, perhaps even within a single forward link time slot.

Once the access terminal receives the reverse traffic channel acknowledgment and the traffic channel assignment message, the access terminal may begin transmitting and receiving on a traffic channel. The traffic channel assignment message specifies each DRC Walsh cover that the access terminal must use in directing DRC messages to each modem pool transceiver in its active set. The Walsh cover used for fast connect reverse traffic channel signals may be used for traffic channel transmissions, and may be specified in the traffic channel assignment message.

FIG. 5 is a diagram showing an example structure for a fast access indicator channel and three staggered fast access channels. Two fast access probe periods **502** are shown for each of three separate fast access channels. Fast access probe periods **502a** and **502d** correspond to a first fast access channel. Fast access probe periods **502b** and **502e** correspond to a second fast access channel. Fast access probe periods **502c** and **502f** correspond to a third fast access channel.

In an exemplary embodiment, the fast access channels are staggered in time, such that a fast access probe **502** that spans multiple reverse link frames may be transmitted beginning on any fast access probe boundary **508**. A different long code mask is used for each of the different fast access channels to allow the modem pool transceiver to distinguish the different channels received. In an exemplary embodiment, eight bits are extracted from the system time to form the PN long code mask used to generate fast access channel signals. Using eight bits enables a modem pool transceiver to receive probes on as many as 256 fast access channels, each having a different long code mask. One skilled in the art will recognize that the techniques described above may alternatively be used to create a greater or lesser set of long code masks for use with a greater or lesser number of fast access channels.

As discussed above, a modem pool transceiver may receive connection request messages from access terminals through a plurality of fast access channels that are staggered in time. In an exemplary embodiment, a single fast

access indicator channel is used to send fast access indicators in response to access probe preambles received on all fast access channels. An access terminal determines which fast access channel is being acknowledged based on the timing of the signal transmitted on the fast access indicator channel. In other words, the fast access indicator channel is time domain multiplexed in order to send fast access indicators corresponding to the different staggered fast access channels.

In an exemplary embodiment, the fast access indicator is covered using a fast access indicator Walsh code associated with a MAC code sub-channel that is reserved exclusively for sending fast access indicators. In an exemplary embodiment, the fast access channels are staggered in time using a fixed offset or "staggering distance." For example, the staggering distance may be one frame (16 time slots) or two frames (32 time slots) or a distance less than a frame such as 8 time slots. The fast access indicator channel is time division multiplexed into separate fast access indicator slots **504** having a duration equal to the staggering distance **506**. In the exemplary embodiment illustrated in **FIG. 5**, the duration of a fast access probe preamble is one frame and is equal to the staggering distance **506**. Thus, one fast access indicator slot **504** is available for responding to a fast access probe preamble received on each fast access channel. Though the fast access indicator slots **504** are shown as beginning and ending exactly on reverse link frame boundaries **508**, they may be offset to allow time for processing of access probe preambles in the modem pool transceiver. For example, the beginning of a fast access indicator slot **504a** may begin one or two time slots later than the previous frame boundary **508a**. In the exemplary embodiment illustrated in **FIG. 5**, a fast access indicator sent during a fast access indicator slot **504b** corresponds to a fast access probe preamble received during the immediately preceding fast access probe preamble period (from **508a** to **508b**).

In an exemplary embodiment, a fast access indicator is a single bit covered with the fast access indicator Walsh code and repeated during each forward link time slot of a fast access indicator slot **504**. When no fast access probe preamble is detected on a fast access channel, the modem pool transceiver reverses the sign of the bit covered with the fast access indicator Walsh code and transmitted during the associated fast access indicator slot **504**. Alternatively, when no fast access probe preamble is detected on a fast access channel, the modem pool transceiver transmits no signal during the associated fast indicator slot **504**, or transmits the fast access indicator signal at approximately zero power.

FIG. 6 is a diagram showing an example fast access probe message sequence. An access terminal transmits a fast access probe **404** containing a connection request message on a fast access channel. The fast access probe **404** includes a fast access probe preamble followed by a fast access probe body. Upon detecting the fast access probe preamble, the modem pool transceiver transmits a fast access indicator **406** on a fast access indicator channel. Upon completing transmission of the fast access probe **404** and receiving the fast access indicator **406**, the access terminal begins transmitting a reverse traffic signal **408**. As discussed above, until the access terminal receives a traffic channel assignment, the reverse traffic signal **408** is sent over a fast connect reverse traffic channel having a predetermined DRC Walsh cover.

In an exemplary embodiment, upon assigning a traffic channel and acquiring the reverse traffic signal **408**, the modem pool transceiver sends the access terminal a combined message **410** containing access probe acknowledgment, traffic channel assignment, and reverse traffic channel acknowledgment messages. As discussed above, the combined message **410** is sent at the rate specified in the DRC signal received from the access terminal on the fast connect reverse traffic channel. After sending the traffic channel assignment, for example as part of the combined message **410**, the modem pool transceiver begins sending forward link traffic **604** on the forward link traffic channel. After receiving the reverse traffic channel acknowledgment message, for example as part of the combined message **410**, the access terminal begins sending data **602** on the reverse link traffic channel.

FIG. 7 is a flowchart of an example access terminal process for establishing a connection using a fast access channel. As discussed above, in step **702** the access terminal obtains a universal access terminal identification (UATI) from the access network prior to establishing a connection. Then, in step **704** in establishing a new connection, the access terminal sends a fast access probe on a fast access channel of a target modem pool transceiver. The fast access probe includes a fast access probe preamble followed by a fast access probe body containing a connection request message. In an exemplary embodiment, the access terminal monitors a forward link channel transmitted by the target modem pool transceiver before sending a fast access probe in order to determine whether the target modem pool transceiver supports fast access probe transmission.

Upon decoding the fast access probe preamble, the target modem pool transceiver sends a fast access indicator indicating that it has successfully decoded at least the first portion of the fast access probe. In step **706**, the access terminal monitors a forward link fast access indicator channel to determine

whether the target modem pool transceiver sends a corresponding fast access indicator. In an exemplary embodiment, the access terminal detects signals on the fast access indicator channel by decovering the associated forward link MAC code sub-channel using a 32-ary Walsh function dedicated to transmitting fast access indicator signals. In an exemplary embodiment, the access terminal attempts to decode the fast access indicator from one of multiple MAC code sub-channels during a predetermined period immediately after transmitting the fast access probe preamble.

If, in step **706**, the access terminal detects a fast access indicator corresponding to the fast access probe preamble, the access terminal begins transmitting a fast connect reverse traffic channel signal in step **708**. While transmitting the fast connect reverse traffic channel signal in step **708**, the access terminal also sends DRC signals requesting a data rate at which signals may be received over the forward rate-controlled common channel. While transmitting **708** the fast connect reverse traffic channel signal, the access terminal monitors the forward link and attempts to decode additional messages used to establish a traffic channel connection. The access terminal monitors both the forward rate-controlled common channel and the forward common control channel to decode an access acknowledgment in step **710**, decode a traffic channel assignment in step **712**, or decode a reverse traffic channel acknowledgment message (RTC-ACK) in step **714**. As discussed above, these three messages may be received individually or in a combined message over the forward rate-controlled forward channel at the specified DRC data rate. Upon successfully decoding a reverse traffic channel acknowledgment in step **722**, the access terminal enters the traffic state in step **724**, and can begin sending and receiving data packets through the modem pool transceiver.

In an exemplary embodiment, the access terminal waits a predetermined amount of time to receive each of the access acknowledgment, traffic channel assignment, and reverse traffic channel acknowledgment messages. If a message is not received within the predetermined timeout period, the access terminal aborts and sends another fast access probe in step **704**. The timeout values associated with each of the different messages may be the same or different. For example, the access terminal may have a longer timeout period associated with the reverse traffic channel acknowledgment than with the traffic channel assignment. Consequently, if neither message is received, the access terminal will abort when the timeout period associated with the traffic channel assignment expires.

The access terminal checks for the expiration of the access acknowledgment timeout in step **710**, then checks for the expiration of the

traffic channel assignment timeout in step **712**, and lastly checks for the expiration of a reverse traffic channel acknowledgment timeout in step **714**. If the access acknowledgment timeout expires in step **710**, then the access terminal aborts and starts over **704**. If the traffic channel assignment timeout expires **712**, then the access terminal aborts and sends another fast access probe in step **704**. If the reverse traffic channel acknowledgment timeout expires in step **714**, then the access terminal aborts and sends another fast access probe in step **704**. The order of the timeout checks depends on the different timeout values and may be different without departing from the described embodiment. In an exemplary embodiment, after the expiration of a timeout for any of the three messages, the access terminal sends an ordinary access probe instead of a fast access probe in step **704**.

If, in step **706**, the access terminal does not detect a corresponding fast access indicator , then the access terminal does not transmit a reverse link traffic channel signal. Because the access terminal is not transmitting DRC signals, the access terminal does not monitor the forward rate-controlled common channel for forward link messages. Instead, the access terminal monitors the forward control channel in order to decode additional messages used to establish a traffic channel connection. The access terminal attempts to decode an access acknowledgment in step **716** and decode a traffic channel assignment message in step **718**. Upon successfully decoding a traffic channel assignment message in step **718**, the access terminal begins transmitting a reverse link traffic channel using the traffic channel parameters specified in the received traffic channel assignment in step **720**. Thereafter, in step **722**, the access terminal may decode a reverse traffic channel acknowledgment on either the forward link traffic channel or the forward control channel. Upon successfully decoding a reverse traffic channel acknowledgment in step **722**, the access terminal enters the traffic state in step **724**, and can begin sending and receiving data packets through the modem pool transceiver.

If the access terminal fails to decode an access acknowledgment, traffic channel assignment, or reverse traffic channel acknowledgment within predetermined timeout periods, the access terminal aborts and sends another fast access probe in step **704**. Alternatively, after failing a first access attempt, the access terminal may make a second access attempt using an ordinary access probe instead of a fast access probe.

FIG. 8 is a flowchart of an example modem pool transceiver process for establishing a connection using a fast access channel. Upon receiving a fast access probe preamble on a fast access channel from an access terminal in step **802**, the modem pool transceiver sends a fast access indicator in step **804**. As

discussed above, the fast access indicator may be sent using one of a plurality of MAC code sub-channels.

While sending the fast access indicator, the modem pool transceiver continues to decode the fast access probe body in step **806** in order to complete the decoding of the fast access probe. If a valid connection request message within the fast access probe body is successfully decoded in step **808**, the modem pool transceiver attempts, in step **810**, to acquire the fast connect reverse traffic channel signal transmitted by the access terminal. Upon acquiring the corresponding fast connect reverse traffic channel the modem pool transceiver extracts DRC information to determine the forward data rate requested by the access terminal. Forward link messages sent to the access terminal may subsequently be transmitted at the requested DRC data rate. These messages include access acknowledgment, traffic channel assignment, and reverse traffic channel acknowledgments. The modem pool transceiver may send these messages individually or combined within a single message. As described above, the modem pool transceiver may transmit these messages using the forward rate-controlled common channel or the forward control channel. In an exemplary embodiment, in step **820**, the modem pool transceiver sends all three messages as a single combined message over the forward rate-controlled common channel. After sending the reverse traffic channel acknowledgment either individually or in a combined message the modem pool transceiver enters the traffic state in step **822**.

If the modem pool transceiver does not acquire the fast connect reverse traffic channel in step **810**, then in step **812** the modem pool transceiver sends the access probe acknowledgment and in step **814** sends the traffic channel assignment in response to the received access probe. The modem pool transceiver then monitors the reverse traffic channel specified in the traffic channel assignment. Upon acquiring the reverse traffic channel in step **816**, the modem pool transceiver sends a reverse traffic channel acknowledgment in step **818** and enters the traffic state in step **822**. Upon failing to acquire the reverse traffic channel in step **816**, the modem pool transceiver aborts and resumes attempting to detect an access probe in step **802**.

FIG. 9 shows an example access terminal apparatus. In the example apparatus, pilot, reverse rate indicator (RRI), DRC, and data signals are signal point mapped in signal point (SP) mapping units **902**. In an exemplary embodiment, SP mapping units **902** perform bi-phase mapping, and convert 0, 1 to +1, -1 respectively. The DRC signal is covered using a DRC cover in mixer **904**. When the access terminal is in the traffic state, the DRC cover corresponds to a selected modem pool transceiver having the greatest DRC rate. When the

access terminal not in the traffic state, but is transmitting over a fast connect reverse traffic channel, the DRC cover is a predetermined fast connect reverse traffic channel Walsh cover.

In an exemplary embodiment, the pilot signal has a constant value, such that the corresponding SP mapping unit **902b** is omitted. The resulting pilot, RRI and DRC signals are time division multiplexed in a time division multiplexing (TDM) module **908**. Alternatively, the mixer **904** may be replaced with an XOR unit, and the DRC signal point mapping unit **902a** may be moved between the XOR unit and the TDM module **908**. If the mixer **904** is replaced by an XOR units, the signal point mapping units **902** may be moved such that there is instead a single signal point mapping unit between the TDM module **908** and a PN spreader **910**.

In an alternate embodiment, the DRC signals are not time division multiplexed with the pilot and RRI signals. Instead, the pilot and RRI signals are time domain multiplexed, and the resulting multiplexed signal is multiplied by a first Walsh code. The DRC signal is multiplied by a second Walsh code that is orthogonal to the first Walsh code. The resulting Walsh-spread DRC signal is then added to the Walsh-spread pilot and RRI signals to form a signal to be spread in PN spreader **910**. In an alternate embodiment, the Walsh-spread DRC signal is individually gain-controlled relative to the Walsh-spread pilot and RRI signals.

The multiplexed signals for the in-phase (I′) component of the input to the PN spreader **910**. In an alternate embodiment, the pilot, RRI and DRC signals are code multiplexed, for example using different orthogonal Walsh codes. The data signal constitutes the quadrature-phase (Q′) component of the input to the PN spreader **910**. One skilled in the art will recognize that the pilot, RRI, DRC and data signals may be arranged in different combinations than those shown to form the I′ and Q′ signals. Also, some or all of the pilot, RRI, DRC and data signals may be added to both I′ and Q′ signals. A complex PN generator **928** generates a complex PN code having an in-phase component (PN_I) and a quadrature-phase component (PN_Q). In an embodiment, the PN spreader **910** complex-multiplies the complex input I' and Q' by the complex PN code PN_I and PN_Q according to the equations:

$$I = I'\,PN_I - Q'\,PN_Q$$
$$Q = I'\,PN_Q + Q'\,PN_I$$

In an alternate embodiment, the PN spreader **910** multiplies the complex input I' and Q' by a single real PN sequence according to the equations:

$$I = I' \, PN$$
$$Q = Q' \, PN$$

Alternatively, other complex or real multiplication equations may be used. One skilled in the art will recognize that complex or real PN codes may be generated in a variety of ways.

The output of the PN spreader **910** is a complex signal having I and Q components. Each of these components is filtered using baseband filters **912** before being upconverted in mixers **914** as shown. The outputs of the mixers **914** are then added in a summer **916** to form the reverse link signal to be amplified in an amplifier **918** and transmitted through an access terminal antenna **920**.

FIG. 10a and **FIG. 10b** show an example modem pool transceiver apparatus. In the example apparatus, RPC and fast access indicator bits are signal point mapped in signal point (SP) mapping units **1002**. In an exemplary embodiment, SP mapping units **1002** perform bi-phase mapping, and convert 0, 1 to +1, -1 respectively.

Signal point mapped RPC bits for an access terminal are gain-controlled in a gain block **1003a**. The gain-controlled RPC signals produced at the output of the gain block **1003a** are mixed in with an RPC Walsh cover in a mixer **1004**. The RPC Walsh cover corresponds to the MAC code channel assigned to the destination access terminal. Though only the gain block **1003a** and the mixer **1004** necessary for one RPC code channel are shown, these elements may be repeated as necessary to accommodate a plurality of RPC code channels within the modem pool transceiver. One skilled in the art will recognize that the gain blocks **1002** and the mixers **1004** may be reversed, such that mixing occurs prior to gain adjustments, without departing from the scope of the present invention.

Signal point mapped Fast access indicator bits are gain-controlled in a gain block **1003b**. As described above, the modem pool transceiver transmits fast access indicator bits in response to the receipt of a fast access probe preamble. The gain-controlled fast access indicator signals produced at the output of gain block **1003b** are mixed in with a fast access indicator Walsh cover in the mixer **1004**. In an exemplary embodiment, the Walsh cover used for the fast access indicator is orthogonal to Walsh covers used for RPC signals.

In an alternate embodiment, the RPC and fast access indicator signals are code multiplexed using codes other than Walsh codes. In another embodiment, the RPC and fast access indicator signals are time division multiplexed.

The Walsh covered MAC code channel signals, including fast access indicator signals and all RPC signals, are summed together in a summer **1008**.

The resultant summed signals are repeated in a repeater **1010** to provide the appropriate number of chips for transmitting the MAC channel (**308** in **FIG. 3**) on either side of the pilot burst (**306** of **FIG. 3**). The MAC channel symbols output by the repeater **1010** are multiplexed with pilot and data channels in a time-domain multiplexer TDM block **1012**. The multiplexed signal stream output by the TDM block **1012** are then multiplied by a complex PN code in a PN spreader **1050**. In an embodiment, the PN spreader **1050** complex-multiplies the complex input I' and Q' by the complex PN code PN_I and PN_Q according to the equations:

$$I = I' \, PN_I - Q' \, PN_Q$$
$$Q = I' \, PN_Q + Q' \, PN_I$$

In an alternate embodiment, the PN spreader **1050** multiplies the complex input I' and Q' by a single real PN sequence according to the equations:

$$I = I' \, PN$$
$$Q = Q' \, PN$$

Alternatively, other complex or real multiplication equations may be used. One skilled in the art will recognize that complex or real PN codes may be generated in a variety of ways.

The resultant complex product output by the PN spreader **1050** includes I and Q components that are each filtered in baseband filters **1052** and then upconverted in mixers **1056**. The upconverted signals output by the mixers **1056** are added together in a summer **1058** to form the forward link signal to be amplified and transmitted by the modem pool transceiver.

The previous descriptions of exemplary embodiments are provided to enable any person skilled in the art to make or use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. For example, where the embodiments are described in terms of 32-ary Walsh functions, any other n-ary Walsh function such 16-ary or 64-ary Walsh functions or other types of orthogonal functions may be readily substituted. Also, the complex PN codes and complex PN spreaders may be readily substituted with simpler real PN codes and PN spreaders.

The components in the exemplary embodiments are described in general terms to illustrate the flexibility of the present invention. Each described

component may be implemented using one or a combination of general-purpose microprocessors, digital signal processors (DSP), programmable logic devices, application specific integrated circuits (ASIC), or any other device designed to perform the functions described herein. Though the access terminal and modem pool transceiver are described in terms of a wireless communication system, the present invention may also be utilized in a network employing access terminals and modem pool transceivers connected by fiber optics or other wire-line technology.

Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

WHAT IS CLAIMED IS:

1. A method of establishing a connection between an access terminal and an access network, the method comprising:

transmitting a first portion of an access probe to the access network;

receiving from the access network on a fast access indicator channel a fast access indicator corresponding to the first portion; and

transmitting, based on the fast access indicator, a fast connect reverse traffic channel signal from the access terminal to the access network, wherein the traffic channel signal comprises data rate control information.

2. The method of claim 1 wherein the fast access indicator is one bit.

3. The method of claim 1 further comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code.

4. The method of claim 1 comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 32 chips.

5. The method of claim 1 comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 64 chips.

6. The method of claim 1 further comprising covering the data rate control information using a predetermined fast connect reverse traffic channel Walsh cover.

7. The method of claim 1 further comprising decoding a traffic channel assignment message received from the access network at a data rate based on the data rate control information.

8. The method of claim 1 further comprising decoding an access probe acknowledgment message received from the access network at a data rate based on the data rate control information.

9. The method of claim 1 further comprising receiving a reverse traffic channel acknowledgment from the access network at a data rate based on the data rate control information.

10. The method of claim 1 further comprising receiving a combined message from the access network at a data rate based on the data rate control information, the combined message comprising a traffic channel assignment message, an access probe acknowledgment message, and a reverse traffic channel acknowledgment.

11. The method of claim 1 wherein said first portion of an access probe is sent on a first fast access channel of a plurality of fast access channels that are staggered in time, and wherein said fast access indicator is sent during a fast access indicator slot immediately following said first portion.

12. The method of claim 1 wherein said first portion of an access probe is transmitted on a first fast access channel of a plurality of fast access channels, wherein each of said plurality of fast access channels uses a different PN long code, and wherein said fast access indicator is identified based on the timing of the first fast access channel.

13. The method of claim 1 further comprising covering said first portion of an access probe using a PN long code having a long code mask based on a system time value.

14. A method of establishing a connection between an access terminal and an access network comprising:

transmitting a traffic channel signal to the access network, the traffic channel signal comprising data rate control information; and

receiving a traffic channel assignment message from the access network at a data rate based on the data rate control information.

15. The method of claim 14 further comprising covering the data rate control information using a predetermined fast connect reverse traffic channel Walsh cover.

16. The method of claim 14 wherein the traffic channel assignment message is received in a single forward link message that further comprises an access probe acknowledgment message, and wherein the a single forward link message is received at a data rate based on the data rate control information.

17. The method of claim 14 wherein the traffic channel assignment message is received in a a single forward link message that further comprises a reverse traffic channel acknowledgment message, and wherein the a single forward link message is received at a data rate based on the data rate control information.

18. The method of claim 14 wherein the traffic channel assignment message is received in a a single forward link message that further comprises a reverse traffic channel acknowledgment message and an access probe acknowledgment message, and wherein the a single forward link message is received at a data rate based on the data rate control information.

19. The method of claim 14 further comprising decoding an access probe acknowledgment message received from the access network at a data rate based on the data rate control information.

20. The method of claim 14 further comprising receiving a reverse traffic channel acknowledgment from the access network at a data rate based on the data rate control information.

21. The method of claim 14 further comprising:

transmitting a fast access probe preamble from the access terminal to the access network; and

receiving from the access network on a fast access indicator channel a fast access indicator corresponding to the fast access probe preamble.

22. The method of claim 21 wherein the fast access indicator is one bit.

23. The method of claim 21 further comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code.

24. The method of claim 21 further comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 32 chips.

25. The method of claim 21 further comprising decovering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 64 chips.

26. The method of claim 21 wherein said fast access probe preamble is sent on a first fast access channel of a plurality of fast access channels that are staggered in time, and wherein said fast access indicator is sent during a fast access indicator slot immediately following said first portion.

27. The method of claim 21 wherein said fast access probe preamble is transmitted on a first fast access channel of a plurality of fast access channels, wherein each of said plurality of fast access channels uses a different PN long code, and wherein said fast access indicator is identified based on the timing of the first fast access channel.

28. The method of claim 21 further comprising covering said first portion of an access probe using a PN long code having a long code mask based on a system time value.

29. A method of establishing a connection between an access terminal and an access network comprising:

receiving a first portion of an access probe from the access terminal;

transmitting a fast access indicator from the access network;

receiving data rate control information from the access terminal; and

transmitting a traffic channel assignment message to the access terminal at a data rate based on the data rate control information.

30. The method of claim 29 wherein the fast access indicator is one bit.

31. The method of claim 29 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code.

32. The method of claim 29 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 32 chips.

33. The method of claim 29 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 64 chips.

34. The method of claim 29 further comprising decovering the data rate control information using a predetermined fast connect reverse traffic channel Walsh cover.

35. The method of claim 29 further comprising transmitting to the access terminal an access probe acknowledgment message at a data rate based on the data rate control information.

36. The method of claim 29 further comprising transmitting a reverse traffic channel acknowledgment to the access terminal at a data rate based on the data rate control information.

37. The method of claim 29 wherein the traffic channel assignment message is transmitted in a a single forward link message that further comprises a reverse traffic channel acknowledgment message and an access probe acknowledgment message, and wherein the a single forward link message is transmitted at a data rate based on the data rate control information.

38. The method of claim 29 wherein said first portion of an access probe is received on a first fast access channel of a plurality of fast access channels that are staggered in time, and wherein said fast access indicator is transmitted during a fast access indicator slot immediately following said first portion.

39. The method of claim 29 further comprising despreading a first fast access channel of a plurality of fast access channels, wherein each of said plurality of fast access channels uses a different PN long code, and wherein said first portion of an access probe is received on the first access channel.

40. The method of claim 29 further comprising despreading said first portion of an access probe using a PN long code having a long code mask based on a system time value.

41. A method of establishing a connection between an access terminal and an access network comprising:

receiving a first portion of an access probe from the access terminal;

transmitting a fast access indicator from the access network;

receiving data rate control information from the access terminal; and

transmitting a combined message to the access terminal at a data rate based on the data rate control signal, the combined message comprising a traffic channel assignment message, an access probe acknowledgment message, and a reverse traffic channel acknowledgment.

42. The method of claim 41 wherein the fast access indicator is one bit.

43. The method of claim 41 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code.

44. The method of claim 41 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 32 chips.

45. The method of claim 41 further comprising covering the fast access indicator using a predetermined fast access indicator Walsh code having a duration of 64 chips.

46. The method of claim 41 further comprising decovering the data rate control information using a predetermined fast connect reverse traffic channel Walsh cover.

47. The method of claim 41 wherein said first portion of an access probe is received on a first fast access channel of a plurality of fast access channels that are staggered in time, and wherein said fast access indicator is transmitted during a fast access indicator slot immediately following said first portion.

48. The method of claim 41 further comprising despreading a first fast access channel of a plurality of fast access channels, wherein each of said plurality of fast access channels uses a different PN long code, and wherein said first portion of an access probe is received on the first access channel.

49. The method of claim 41 further comprising despreading said first portion of an access probe using a PN long code having a long code mask based on a system time value.

50. An access terminal apparatus comprising:

a system time processor configured to generate a system time signal;

a PN long code generator configured to generate a first PN long code using a long code mask based on the system time signal; and

a PN spreader configured to multiply an access channel probe signal by the first PN long code.

51. The apparatus of claim 50 further comprising a mixer configured to multiply a data rate control signal by a predetermined fast connect reverse traffic channel Walsh cover to produce a covered data rate control signal, wherein the PN spreader is further configured to spread the covered data rate control signal by a second PN long code.

52. The apparatus of claim 50 wherein the first PN long code is a complex PN long code, and wherein the PN spreader is configured to perform complex multiplication of the PN long code by the access channel probe signal.

53. An access network apparatus comprising:

a mixer configured to mix a fast access indicator signal with a fast access indicator Walsh cover to produce a covered fast access indicator signal; and

a PN spreader configured to multiply the covered fast access indicator signal by a PN code.

54. The apparatus of claim 53 further comprising at least one mixer configured to multiply at least one reverse power control signal by at least one reverse power control Walsh cover, wherein each of the at least one reverse power control Walsh covers is orthogonal to each other reverse power control Walsh cover, and wherein each of the at least one reverse power control Walsh covers is orthogonal to the fast access indicator Walsh cover.

55. The apparatus of claim 53 further comprising a gain block configured to adjust the gain of the fast access indicator signal.

56. The apparatus of claim 53 further comprising a signal point mapping unit configured to map a binary signal to +1 and -1 to produce the fast access indicator signal.

57. The apparatus of claim 53 wherein the PN code is a complex PN code, and wherein the PN spreader is configured to perform complex multiplication of the complex PN code by the fast access indicator signal.

58. An access terminal apparatus comprising:

means for transmitting a first portion of an access probe to the access network;

means for receiving from the access network on a fast access indicator channel a fast access indicator corresponding to the first portion; and

means for transmitting, based on the fast access indicator, a fast connect reverse traffic channel signal from the access terminal to the access network, wherein the traffic channel signal comprises data rate control information.

59. An access network apparatus comprising:

means for receiving a first portion of an access probe from the access terminal;

means for transmitting a fast access indicator from the access network;

means for receiving data rate control information from the access terminal; and

means for transmitting a traffic channel assignment message to the access terminal at a data rate based on the data rate control information.

ABSTRACT

In a high data rate communication system, a method and apparatus for efficiently establishing a connection between an access terminal and an access network using a fast access channel and a fast access indicator. Upon receiving a fast access indicator in response to a fast access probe, an access terminal begins transmitting a traffic channel signal containing data rate control (DRC) information. The DRC information is used by the access network to transmit messages such as a traffic channel assignment message at the requested DRC rate.

FIG. 1

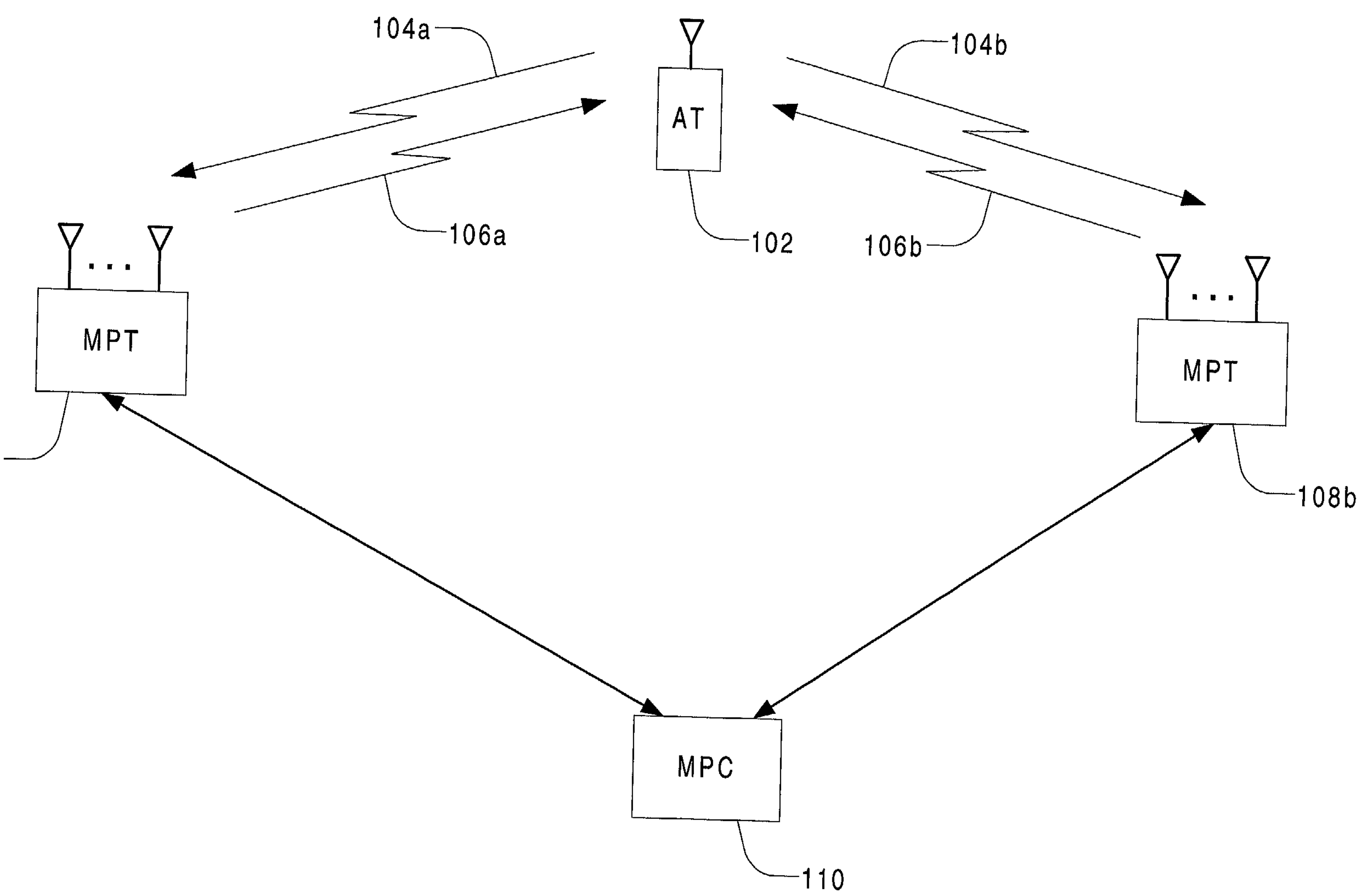


FIG. 2a

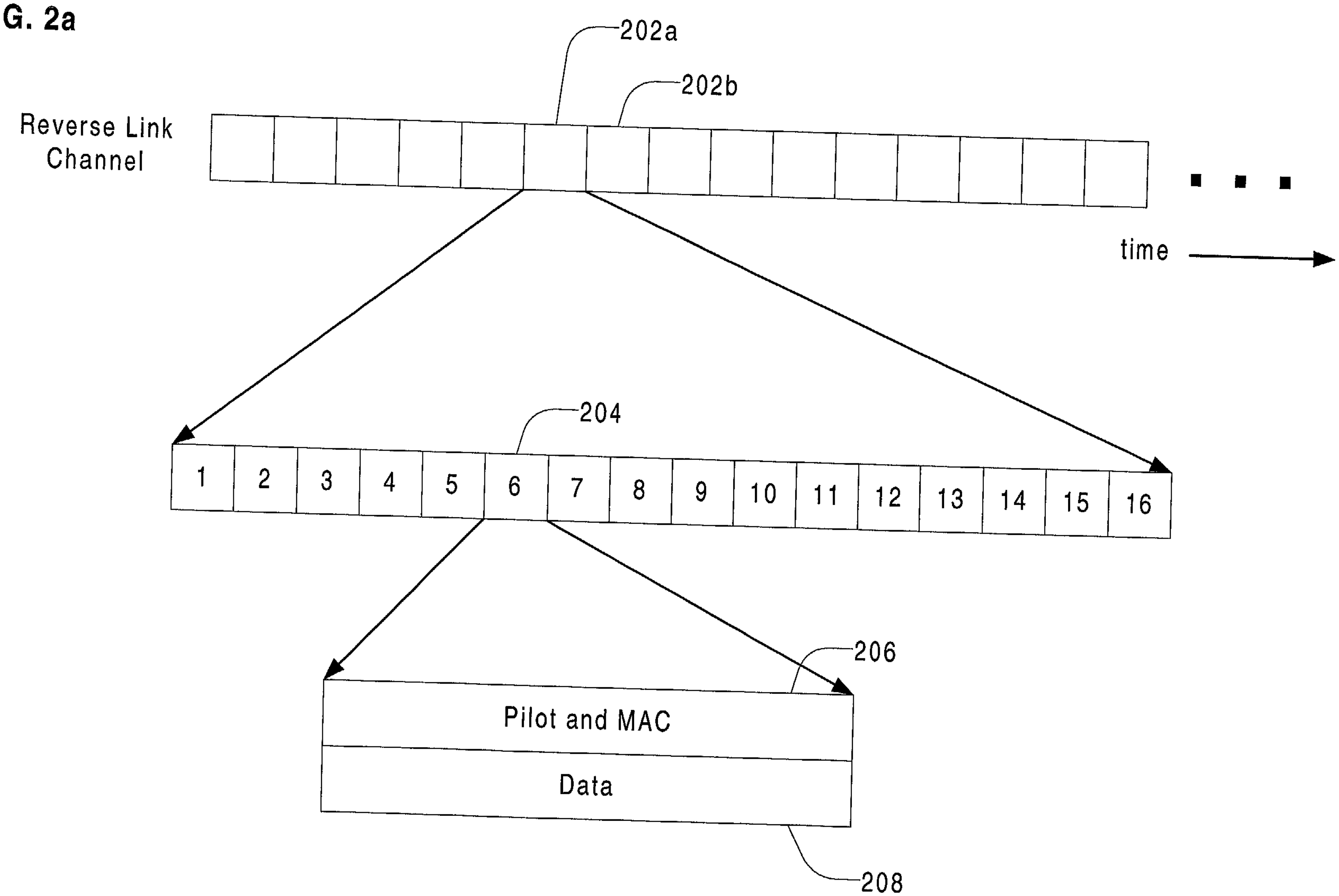

202a
202b
Reverse Link
Channel
time
204
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
206
Pilot and MAC
Data
208

FIG. 2b

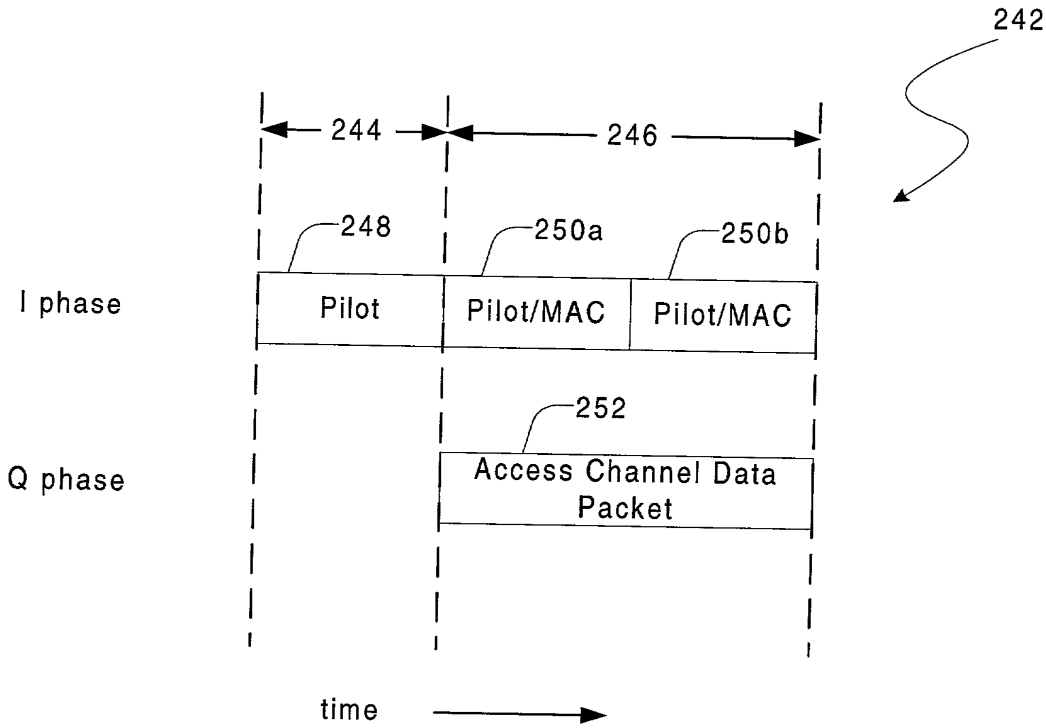
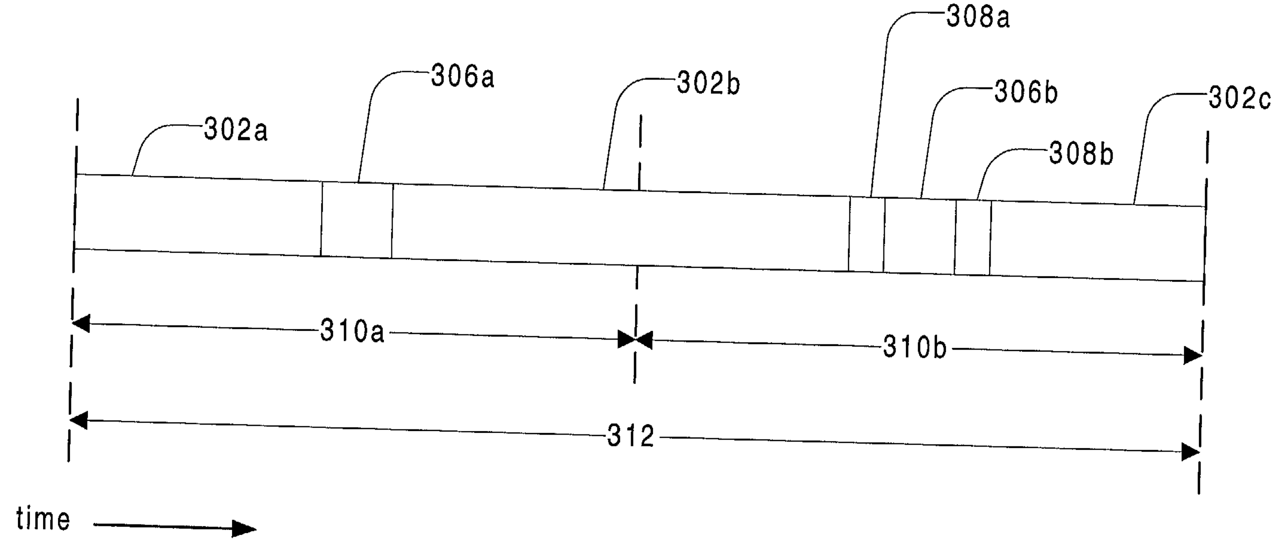
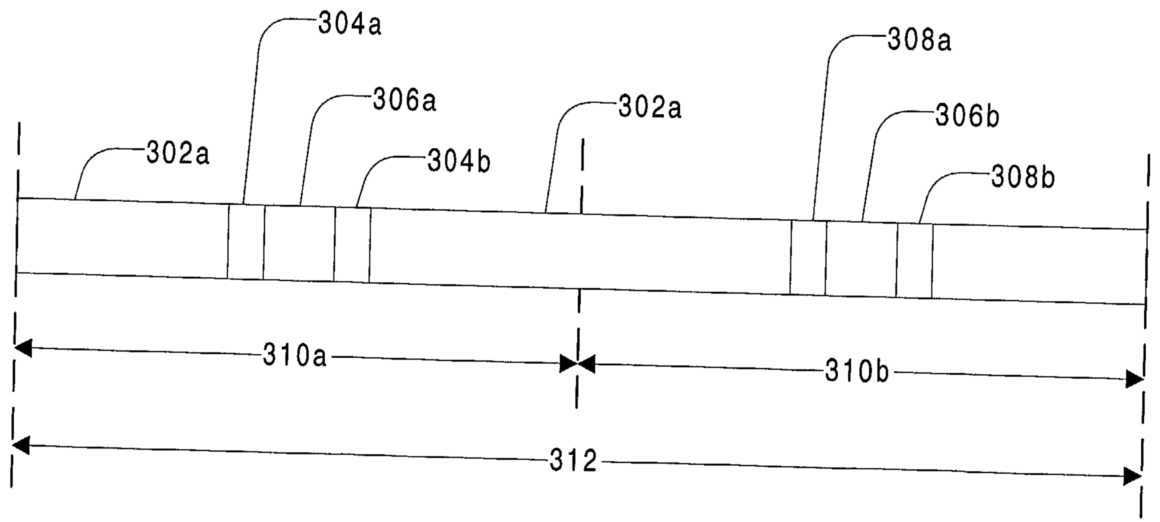

242
244
246
248
250a
250b
I phase
Pilot
Pilot/MAC
Pilot/MAC
252
Q phase
Access Channel Data Packet
time

FIG. 3a



302a
306a
302b
308a
306b
308b
302c
310a
310b
312
time

FIG. 3b



302a
304a
306a
304b
302a
308a
306b
308b
310a
310b
312

FIG. 4

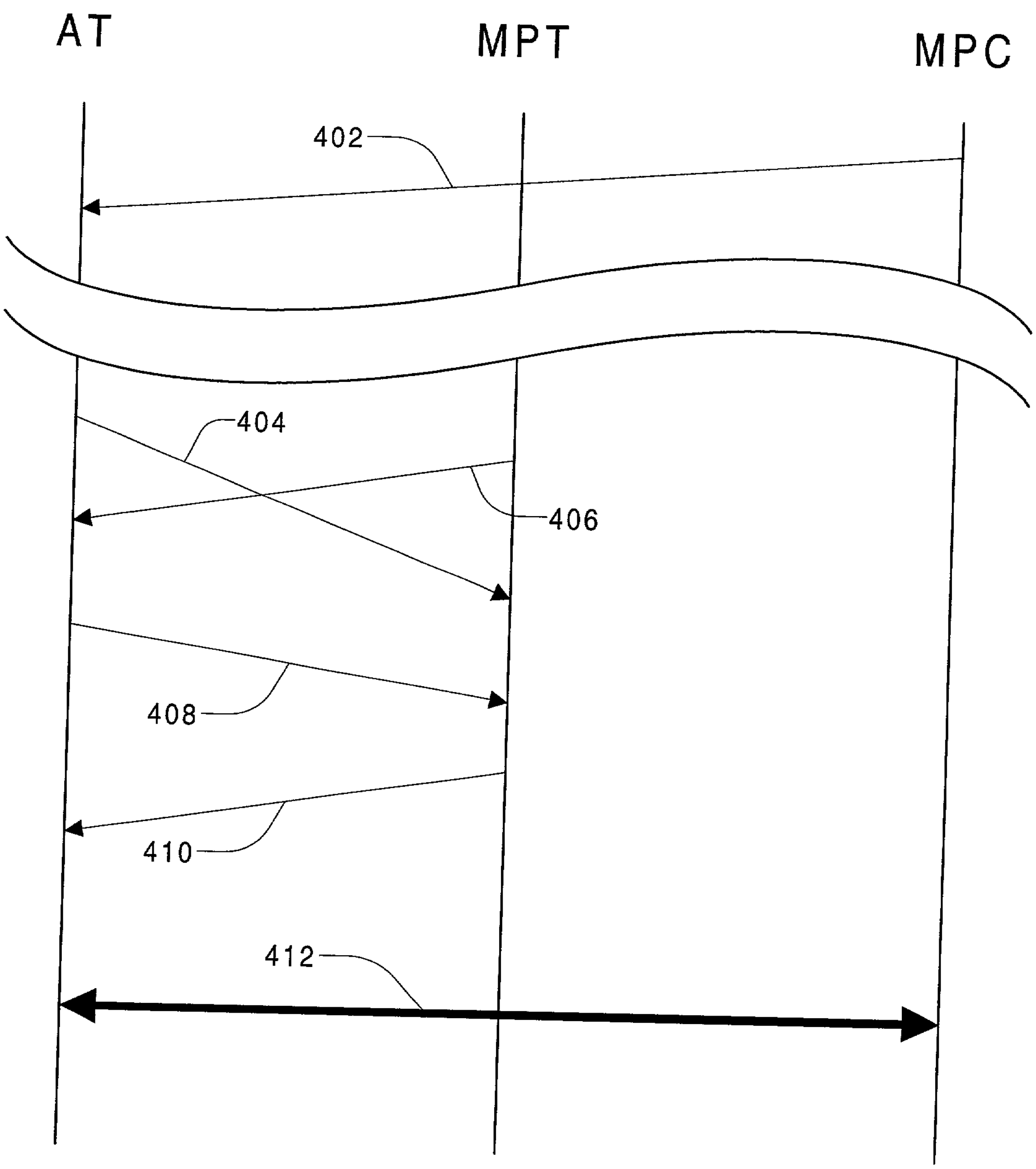


FIG. 5

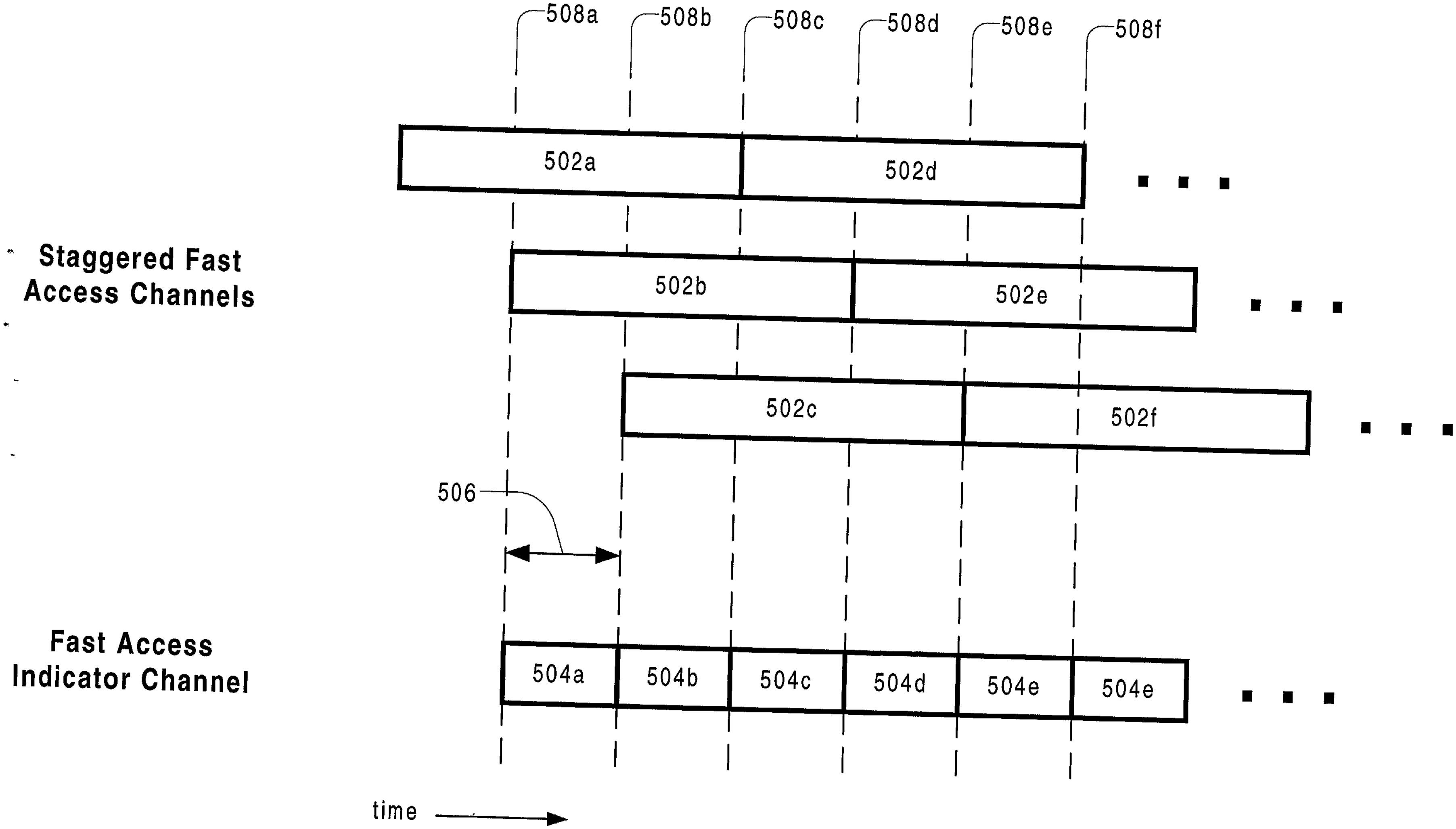
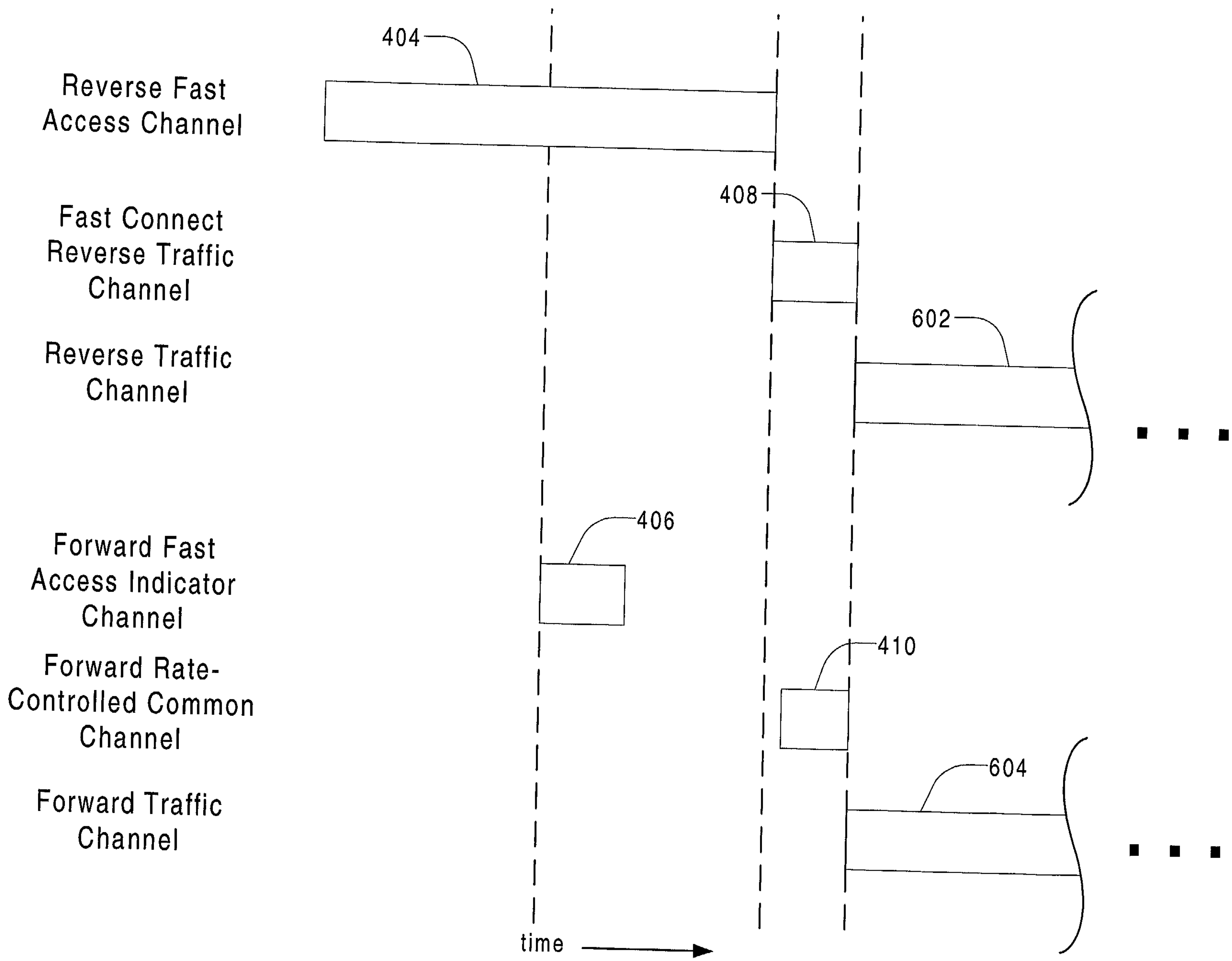
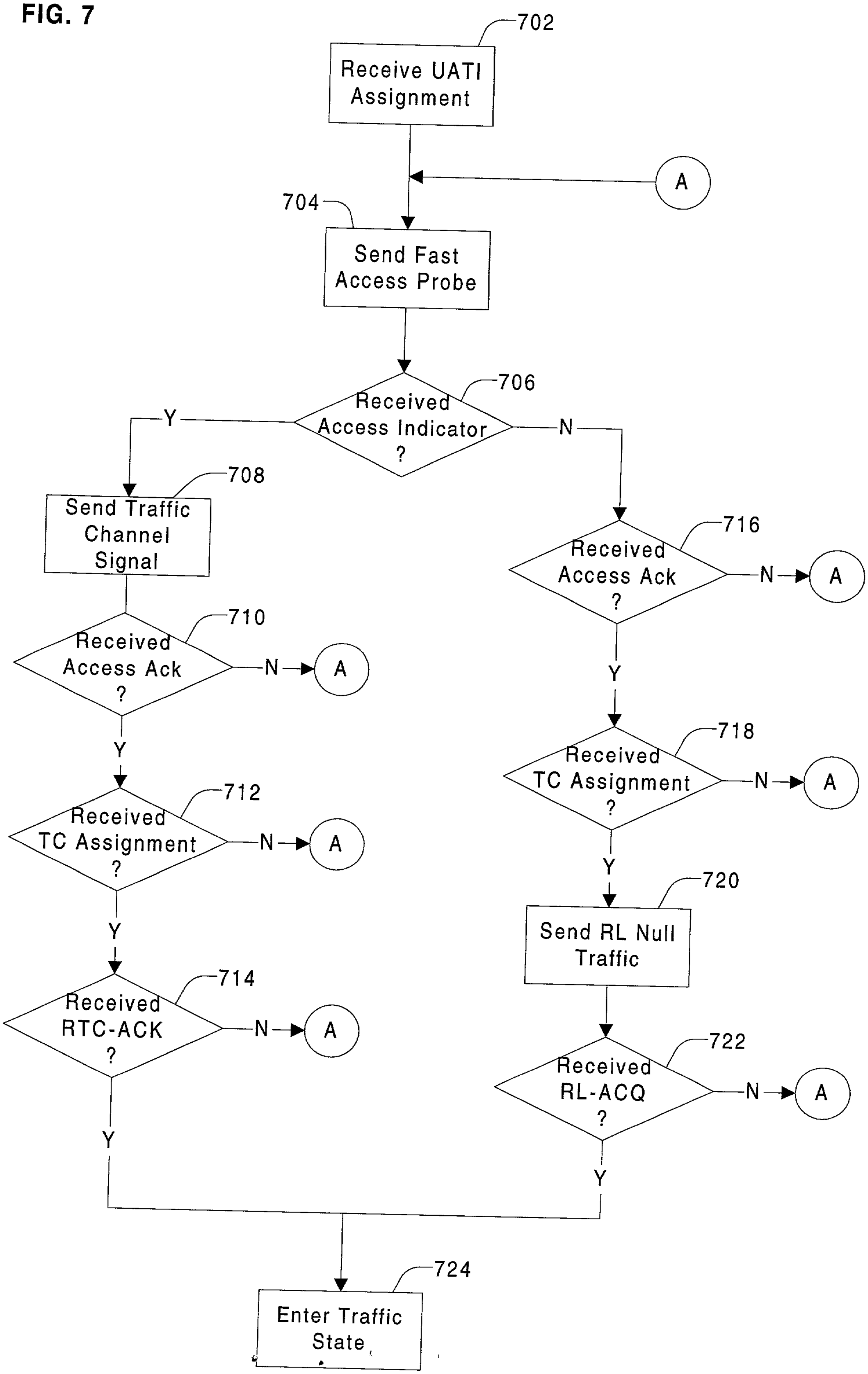

508a
508b
508c
508d
508e
508f
Staggered Fast Access Channels
502a
502d
502b
502e
502c
502f
506
Fast Access Indicator Channel
504a
504b
504c
504d
504e
504e
time

FIG. 6



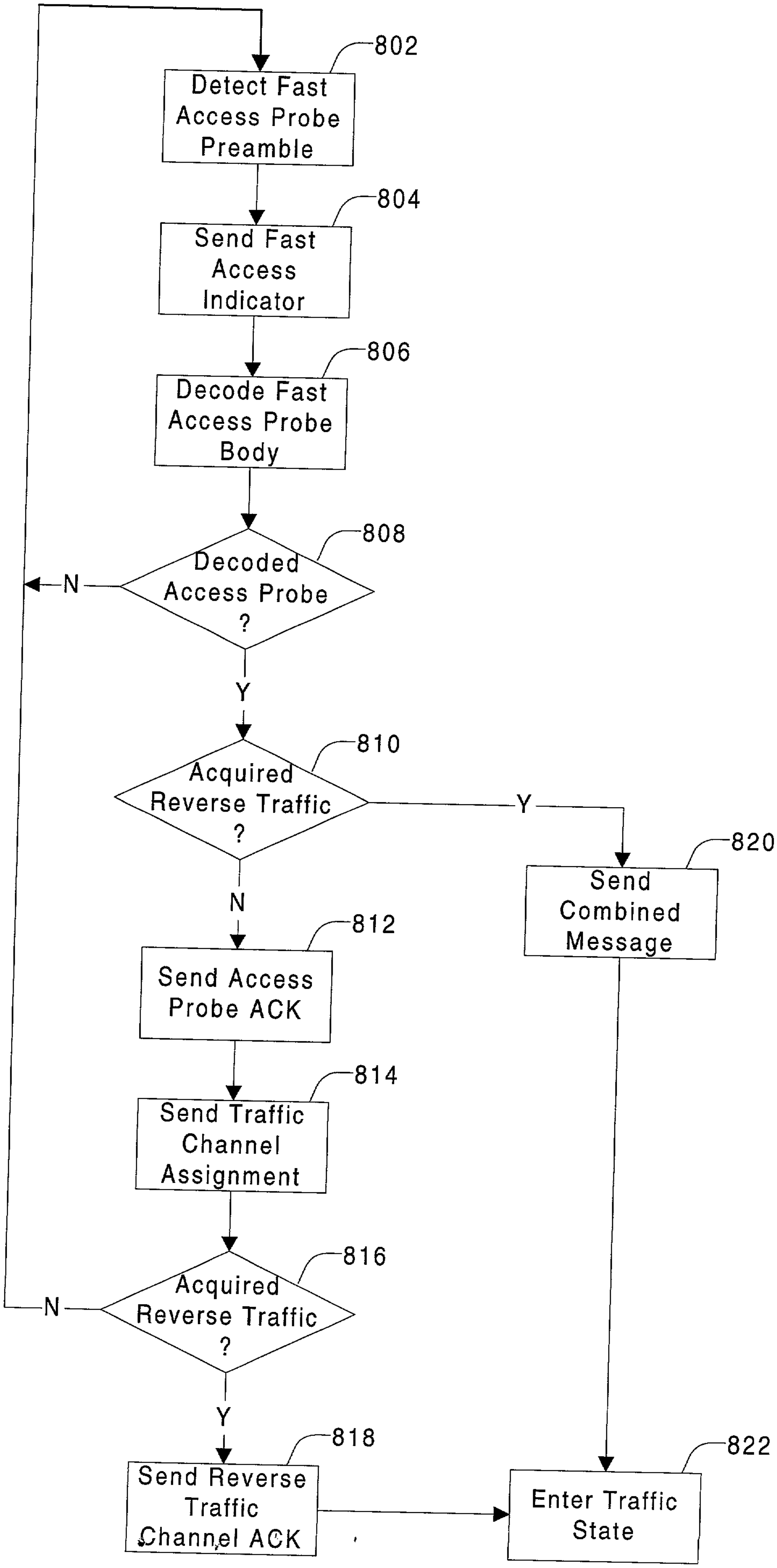
Reverse Fast Access Channel
Fast Connect Reverse Traffic Channel
Reverse Traffic Channel
Forward Fast Access Indicator Channel
Forward Rate-Controlled Common Channel
Forward Traffic Channel
404
408
602
406
410
604
time

FIG. 7



702
Receive UATI Assignment
A
704
Send Fast Access Probe
706
Received Access Indicator ?
Y
N
708
Send Traffic Channel Signal
710
Received Access Ack ?
N
A
Y
712
Received TC Assignment ?
N
A
Y
714
Received RTC-ACK ?
N
A
Y
716
Received Access Ack ?
N
A
Y
718
Received TC Assignment ?
N
A
Y
720
Send RL Null Traffic
722
Received RL-ACQ ?
N
A
Y
724
Enter Traffic State

FIG. 8



802
Detect Fast Access Probe Preamble
804
Send Fast Access Indicator
806
Decode Fast Access Probe Body
808
Decoded Access Probe ?
N
Y
810
Acquired Reverse Traffic ?
Y
N
812
Send Access Probe ACK
814
Send Traffic Channel Assignment
816
Acquired Reverse Traffic ?
N
Y
818
Send Reverse Traffic Channel ACK
820
Send Combined Message
822
Enter Traffic State

FIG. 9

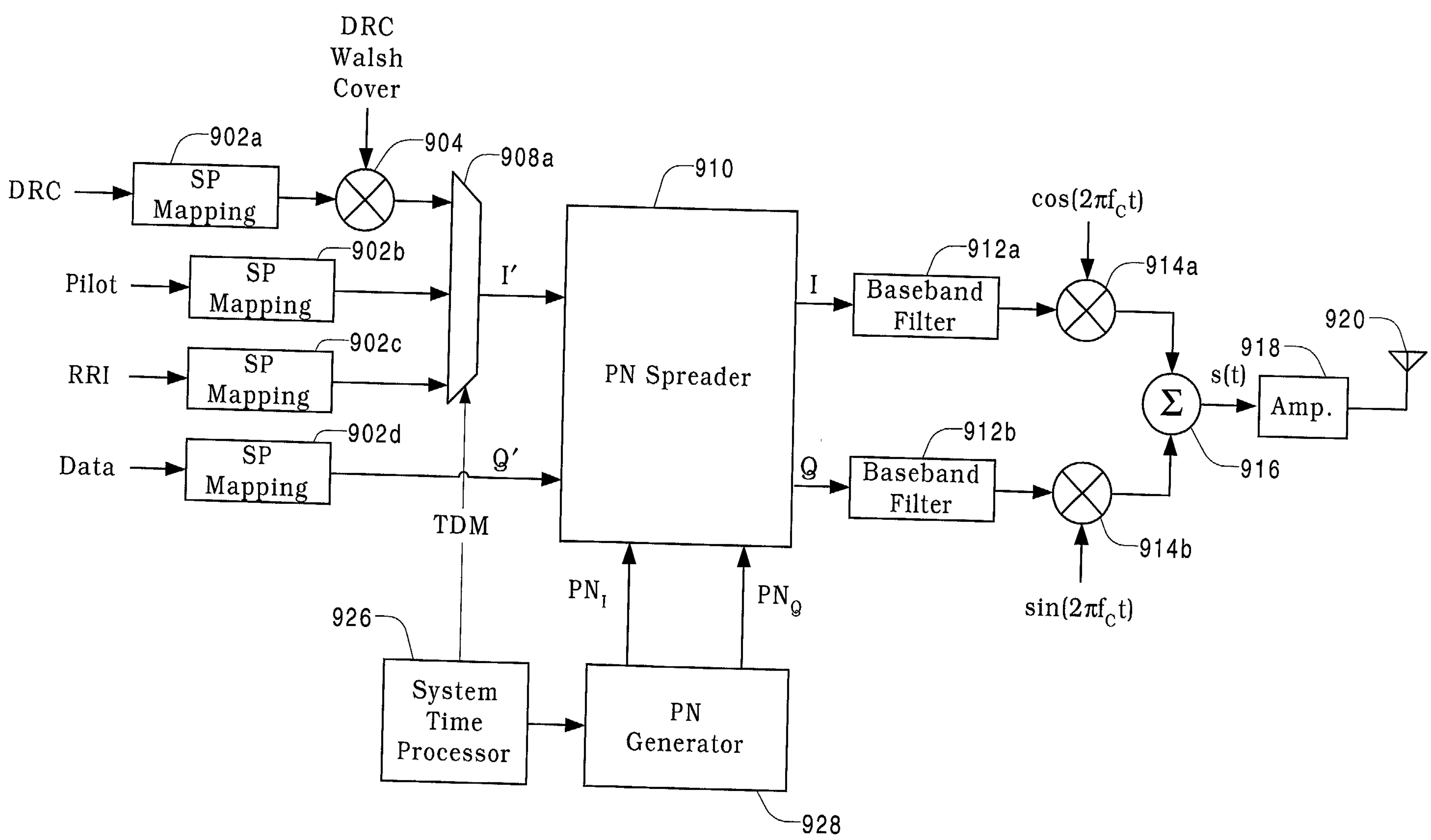

DRC
Pilot
RRI
Data
SP Mapping
902a
902b
902c
902d
DRC Walsh Cover
904
908a
I′
Q′
TDM
910
PN Spreader
I
Q
PN_I
PN_Q
926
System Time Processor
PN Generator
928
912a
912b
Baseband Filter
$\cos(2\pi f_C t)$
$\sin(2\pi f_C t)$
914a
914b
Σ
916
s(t)
918
Amp.
920

FIG. 10a

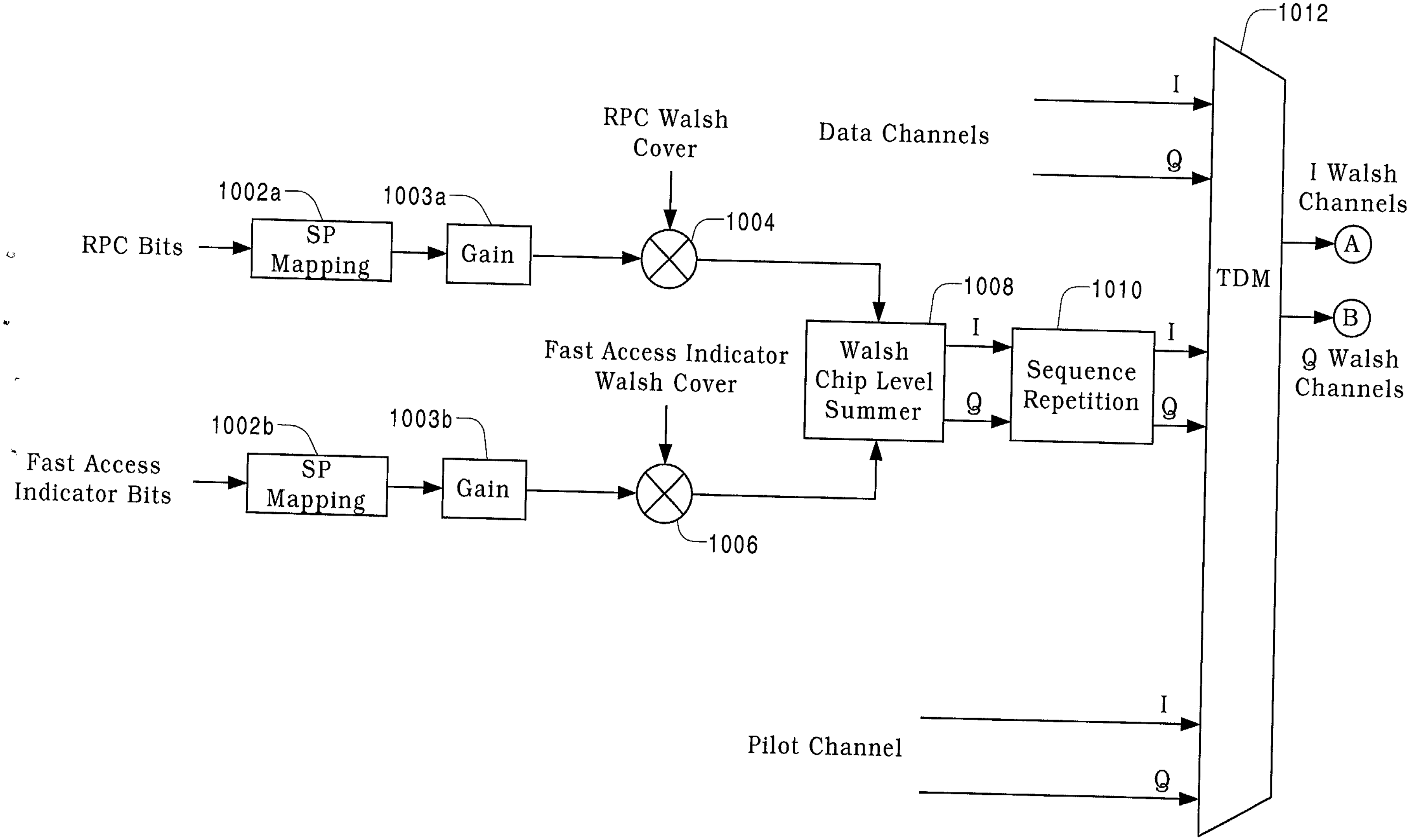
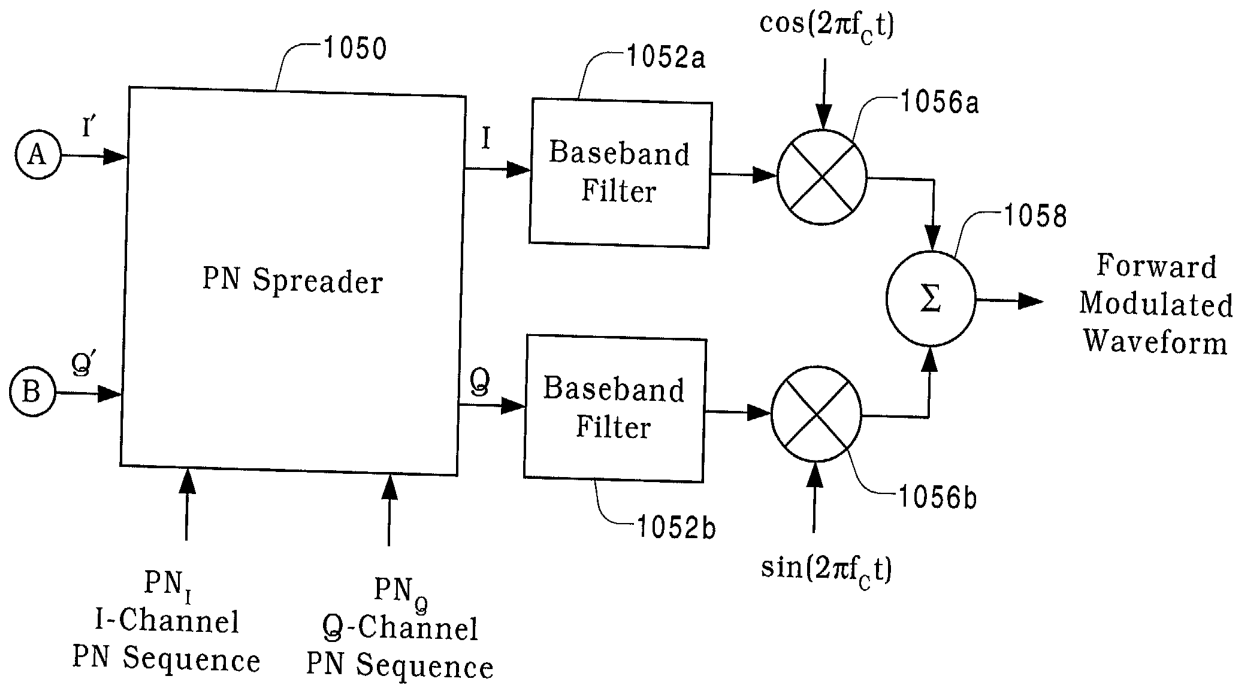

RPC Bits
1002a
SP Mapping
1003a
Gain
RPC Walsh Cover
1004
Fast Access Indicator Bits
1002b
SP Mapping
1003b
Gain
Fast Access Indicator Walsh Cover
1006
Walsh Chip Level Summer
1008
I
Q
Sequence Repetition
1010
I
Q
Data Channels
I
Q
Pilot Channel
I
Q
TDM
1012
I Walsh Channels
A
B
Q Walsh Channels

FIG. 10b



1050
PN Spreader
A
I′
B
Q′
I
Q
PN_I
I-Channel
PN Sequence
PN_Q
Q-Channel
PN Sequence
1052a
Baseband
Filter
1052b
Baseband
Filter
cos(2πf_C t)
sin(2πf_C t)
1056a
1056b
1058
Σ
Forward
Modulated
Waveform

COMBINED DECLARATION / POWER OF ATTORNEY

ATTORNEY DOCKET NO.: PA000028

AS BELOW NAMED INVENTOR, I HEREBY DECLARE THAT: This Declaration is of the following type:

☒ Original ☐ Supplemental ☐ Continuation-In-Part ☐ Divisional
☐ Continuation ☐ National Stage of PCT

My residence, post office address and citizenship are as stated below next to my name: I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention METHOD AND APPARATUS FOR ADAPTIVE TRANSMISSION CONTROL IN A HIGH DATA RATE COMMUNICATION SYSTEM the specification of which:

☒ is attached hereto.
☐ was filed on as Serial No. .
☐ was amended on (if applicable).
☐ was described and claimed in PCT International Application No. filed on and as amended under PCT Article 19 on .

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Sec. 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Sec. 119 of any foreign application(s) for patent or inventor's certificate or of any PCT International application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

			Priority Claimed	
(Country)	(Application No.)	(Day/Month/Year/Filed)	(Yes)	(No)

I hereby claim the benefit under Title 35 USC 120 of the United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 USC 112, I acknowledge the duty to disclose material information as defined in Title 37 CFR 1.56(a) which occurred between the filing date of the prior application and the national or PCT International filing date of this application:

(Serial No.)	(Filing Date)	(Status)

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith: Russell B. Miller, Reg. No. 31,122, Gregory D. Ogrod, Reg. No. 30,880, Bruce W. Greenhaus, Reg. No. 37,339, Charles D. Brown, Reg. No. 28,285, Thomas R. Rouse, Reg. No. 40,793, Kent D. Baker, Reg. No. 38,822, Thomas M. Thibault, Reg. No. 42,181, Tom Streeter, Reg. No. 32,007, Christopher O. Edwards, Reg. No. 36,127, Pavel Kalousek, Reg. No. 44,178, Kyong H. Macek, Reg. No. 42,977, Byron Yafuso, Reg. No. 45,244, Raymond B. Hom, Reg. No. 44,773, Kevin J. Clark, Reg. No. 42,421, Sean English, Reg. No. 37,319, Roger W. Martin, Reg. No. 39,291, Sandip S. Minhas, Reg. No. 44,945, Michael D. Hartogs, Reg. No. 36,547, Philip R. Wadsworth, Reg. No. 29,219, S. Hossain Beladi, Reg. No. 42,311, Albert J. Harnois, Reg. No. 46,123, Sandra L. Godsey, Reg. No. 42,589, and Maryanne E. DeAngelo, Reg. No. 47,288. Please direct all telephone calls to Philip R. Wadsworth at (858) 651-4404 and address all correspondence to: Sarah Kirkpatrick, Manager, Intellectual Property Administration, QUALCOMM Incorporated, 5775 Morehouse Drive, San Diego, California 92121-1714.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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[pa000028 dec/poa]